REMARKS

Claims 1-10 and 12 were rejected under 35 U.S.C. 103 over Fukuta in view of Nishigaki '921 and '066 and Martin. In addition, claims 3-7 were rejected under 35 U.S.C. 103 over the same combination of references taken in combination with Hakotani. Both of these rejections are respectfully traversed.

The present invention relates to a "non-shrinkage" process for sintering a green ceramic laminate. In such a process, the green ceramic laminate is sandwiched between constraining layers which do not sinter at the sintering temperature of the laminate in order to force the shrinkage to be in the thickness direction while inhibiting shrinkage in the principle surface direction of the laminate. As a result, the non-uniform deformation normally encountered does not easily occur when firing the green laminate, making it possible to prevent undesired deformation and strain in wiring conductors and enabling an increase in the density of those conductors.

The individual layers of the laminate contain a low temperature sintering combination of a ceramic powder and a glass component, and a binder. During firing, the ceramic powder becomes densified and so doing, it is important to maintain the fluidity of the glass component during the firing process. However, when the glass component precipitates a crystalline substance, the viscosity of the glass increases as the precipitation takes place and that results in a loss of the fluidity of the glass component which, in turn, interferes with the densification of the ceramic powder. The present invention is based, at least in part, on the discovery that when the rate of temperature increase from the binder removal to sintering is more than about 20°C per/minute to precipitate forsterite, akermanite or diopside crystalline substances, the problems attendant to the increase in viscosity can be overcome.

The principle reference, Fukuta, discloses a non-shrinkage process using constraining layers but does not, as the Examiner has pointed out, teach or suggest the recited heating rate or the precipitation of crystalline forsterite, akermanite or diopside

from the glass being sintered. To overcome these deficiencies, reference has been made to the two (2) Nishigaki references and Martin. The Hakotani reference has been cited only to show multilayer ceramic substrates are for mounting and interconnecting electronic components.

The Nishigaki '921 reference relates to a method for manufacturing low temperature fired ceramics without using a constraining layer. Thus this reference is not concerned about a non-shrinkage process and considerations relevant to the existence of a constraining layer are thus irrelevant to its teaching. In the passage starting at the bottom of col. 6 the reference points out the importance of expelling gases being released by the ceramic material and as a result of decomposition of the binder. Even so, the reference is concerned with the ignition problem during heating and therefore discloses addressing this problem through control of the air feed rate. Nishigaki is able to use a high heating rate because of the air introduction control. The effect of the constraining layers, which by their very presence, would interfere with the elimination of the ignitable degradation gases, is not a consideration. Nothing in this reference teaches or suggest that a rapid heating rate can be used for any purpose in the context of a non-shrinking process. Since Fukuta teaches a non-shrinkage process, as does the present invention, there is no basis on which those skilled in the art would combine these two references. The combination of these references is, therefore, respectfully submitted to be improper.

Beyond the foregoing, the Nishigaki '921 reference teaches a process in which the low temperature ceramic is a mixture of certain "specified non-crystallized glass compositions and alumina before firing" which result in "forming . . . anorthite" as a result of the firing. See col. 6, lines 26-40. The glass component in the present invention, in contrast, precipitates crystalline forsterite, akermanite or diopside during firing. Accordingly, even if this reference was combined with Fukuta, and it is respectfully submitted such combination would be improper, the resulting combination would not be the present invention.

The other Nishigaki patent ('066) has been cited to indicate that certain glass is made (or may not) include impurities which may (or may not) include MgO and Martin has been cited to show that certain glasses crystallize an akermanite containing phase. Given the fact that Nishigaki '921 uses glasses which precipitate anorthite, it is respectfully submitted that such teachings are not relevant. Further, there is no suggestion in these references which would lead one skilled in the art to make the appropriate selections to realize a glass that precipitates akermanite and use it in the Fukuta process.

In light of all of the foregoing considerations, it is respectfully submitted that all rejections should be withdrawn and that this application is not in condition to be allowed. Accordingly, the early issuance of a Notice of Allowance is respectfully solicited.

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Respectfully submitted,

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